LONGBOW APACHE

Army ACAT IC Program		**Prime Contractor**
Total Number of Systems:	743	Boeing
Total Program Cost (TY$):	$9.9B	
Average Unit Cost (TY$):	$11.3M	
Full-rate production:	1QFY96	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2010

The AH-64D Longbow Apache is a remanufactured and upgraded version of the AH-64A Apache attack helicopter. The primary modifications to the Apache are the addition of a millimeter-wave Fire Control Radar (FCR) target acquisition system, the fire-and-forget Longbow Hellfire air-to-ground missile, updated T700-GE-701C engines, and a fully integrated cockpit. In addition, the aircraft receives improved survivability, communications, and navigation capabilities. Most existing capabilities of the AH-64A Apache are retained.

The AH-64D is being fielded in two configurations. The full-up AH-64D includes all of the improvements listed above. In addition, a version of the AH-64D without the FCR will be fielded. This version will not receive the new Radar Frequency Interferometer or the improved engines, but will retain the other Longbow modifications. The AH-64D without FCR is capable of launching the Longbow Hellfire missile.

Five hundred and thirty AH-64A Apaches in the fleet are to be upgraded to the AH-64D configuration. Five hundred will be equipped with the FCR, and the remaining 30 will not. The current plan is to provide all eight attack aircraft in an attack company with the FCR.

The mission of the attack helicopter is to conduct rear, close, and deep operations; deep precision strike; and armed reconnaissance and security when required in day, night, or adverse weather conditions. The AH-64D is a ***dominant maneuver*** platform that leverages ***information superiority*** and ***tactical precision engagement*** to provide ***full-dimensional protection*** for the ground maneuver force.

BACKGROUND INFORMATION

The combined Longbow Apache and Longbow Hellfire IOT&E) was conducted in four phases: (1) gunnery; (2) force-on-force; (3) air transportability; and (4) aircraft conversion. The gunnery phase of IOT&E was conducted during January-February 1995, at the Naval Weapons Center, China Lake, CA. Testing conducted at Ft. Hunter Liggett, CA, during March 1995, compared the Longbow Apache firing the Longbow and Semi-Active Laser missiles with the baseline AH-64A. The objectives of this phase were to assess the operational effectiveness of an attack helicopter company equipped with the Longbow weapon system relative to one equipped with the current AH-64A, and to assess the operational suitability of the aircraft. Both the test and baseline attack helicopter companies conducted missions against a battalion-size enemy force, augmented with formidable air defenses. A real-time casualty assessment system was used for kill removal. Air transportability and aircraft conversion demonstrations were conducted at the contractor facility.

One issue uncovered during IOT&E that required follow-on testing involved a method of employment for the Longbow Hellfire missile. During the IOT&E's force-on-force phase, Longbow Apache crews frequently overrode the system's automatic firing mode selection and fired missiles from a masked position using the Lock-On Before Launch Inhibit (LOBL-I) firing mode. This powerful technique significantly increased the helicopter's survivability during IOT&E, but had not been validated with live missile firings during preceding DT/OT.

The DAB authorized full-rate production of the aircraft and radar in October 1995. The attendant ADM, dated October 18, 1995, required OSD approve the Army's plan to test the LOBL-I mode of engagement. The ADM also stated that testing would culminate with missile firings at moving targets.

TEST & EVALUATION ACTIVITY

OSD (DOT&E) worked with the Army to develop a plan for a Follow-On Test (FOT) of the LOBL-I engagement to confirm system performance using this firing technique. The test program included digital simulations of the missile's target acquisition and fly-out, Hardware-in-the-Loop (HWIL) testing of the guidance section, low-speed captive flight test (LSCFT) of the missile seeker, and live missile firings at moving armored vehicles. The simulations, LSCFT, and four of the planned eight missile firings were completed in FY99. The missile firings were suspended to address some software anomalies that surfaced as a result of testing.

TEST & EVALUATION ASSESSMENT

IOT&E and LFT&E were conducted in accordance with the approved TEMP (September 1994). As reported to Congress in the October 1995 B-LRIP report and Live Fire Test report, these tests were adequate to provide the information necessary to determine the system operationally effective, suitable, and survivable. Specifically, the AH-64D was found to be substantially more effective than the AH-64A in its IOT&E. During the gunnery phase, the AH-64D was able to acquire and effectively engage targets in obscuration that precluded engagement by the AH-64A. During force-on-force testing, the AH-64D force was significantly more lethal and survivable than the AH-64A force.

The Longbow Apache was also found to be suitable for fielding. The system met its reliability and maintainability requirements although several objectives were not achieved. AH-64D operational availability compared favorably with the AH-64A, although the system fell short of wartime availability objectives.

Longbow Apache conducted a Live Fire Test and Evaluation program in the1993-95 timeframe. One of the vulnerability questions identified at that time was ballistically induced engine bay fires. The Apache engine bay had been tested previously, but the engine had been upgraded and the projection was that the Halon-based fire extinguishing system would soon be replaced. The LFT&E program was conducted with the understanding that engine bay testing was to be completed after a Halon replacement agent was identified. Since then, DOD has been allowed to use Halon from a Halon bank and the Longbow Apache fire extinguishing system continues to be Halon-based. As a result, the engine bay has not been re-tested. DOT&E continues to monitor the situation to ensure that if any changes are made, the updated system will be adequately tested.

One issue uncovered during the Initial Operational Test (IOT) that required an FOT involves the LOBL-I method of employment for the Longbow Hellfire missile. The LOBL-I FOT, conducted in accordance with the OSD approved plan, was a remarkably innovative use of modeling and simulation (M&S) to support OT&E. In this instance, M&S was used to characterize the missile's performance in the LOBL-I mode in a far wider range of conditions than could be examined using just field testing. Factors such as target range and time delay (the time between locating the target and firing the missile) were varied based on what was observed during the IOT&E's force-on-force test results. Only after the M&S results were analyzed were informative cases selected for LSCFT and live fire missile shots. The results from the LSCFT and the missile firings were then compared to the M&S predictions to help further validate the simulation models. This was a noteworthy example of field test results (from the IOT&E) supporting M&S (digital, HWIL, and LSCFT), the results of which supported field testing (live missile shots).

The LOBL-I FOT was suspended on shot four of eight live missile shots scheduled due to software anomalies (high number of unexplained false returns on possible targets). Once the software anomalies are fixed, the conditions on shot number four will be tested again to confirm the software fix. The LOBL-I FOT will continue with shots five through eight.

Taken in its entirety, data from digital and HWIL simulations, LSCFT, and missile firings quantified key factors significantly affecting the missile's probability of acquiring and hitting the target when fired in the LOBL-I mode. These factors include target range, time delay (the time between locating the target and firing the missile), target radial velocity (target speed and aspect angle), and the ability of the missile software to reject background clutter when searching for higher speed targets at longer ranges.

LESSONS LEARNED

As explained above, Longbow Apache crews frequently used the LOBL-I method of engagement during IOT&E's force-on-force phase to fire missiles from a masked position and thereby reduce their susceptibility to engagement by threat air defense systems. The crews' clear preference for this mode was not discovered until the aircrews encountered a sufficiently realistic air defense threat environment during IOT&E.

The Army's (PM Longbow Hellfire and Apache) approach to subsequent LOBL-I testing, to investigate the impact of that mode on the missiles probability of hit, was a good example of using M&S to support OT&E. Importantly, however, the program illustrates the criticality of confirming M&S results with realistic field testing. The software anomalies that led to the suspension of post-IOT live missile shots would not have been detected or the subsequent revision of the missile seeker software implemented otherwise.